Molecular Formula Determination

p. 118 #3 In 100g

$m_C = 68.54g$ $\xrightarrow{\text{\# mm}}$ $n_C = 5.71$

$m_H = 8.63g$ $\quad n_H = 8.54$

$m_O = 22.83g$ $\quad n_O = 1.43$

C : H : O

$\Rightarrow \frac{5.71}{1.43} : \frac{8.54}{1.43} : \frac{1.43}{1.43}$

4 : 6 : 1 $\quad \therefore C_4H_6O$ Emp. Form.

MM of Unknown = 140.20 g/mol

MM of Emp. Form. = 70.10 g/mol $\uparrow \times 2$

$\therefore$ Unknown is $C_8H_{12}O_2$

#4 In 100g

$m_C = 76.5g$ $\xrightarrow{\text{\# mm}}$ $n_C = 6.37$

$m_H = 12.2g$ $\quad n_H = 12.08$

$m_O = 11.3g$ $\quad n_O = 0.706$

C : H : O

$\Rightarrow \frac{6.37}{0.706} : \frac{12.08}{0.706} : \frac{0.706}{0.706}$

9 : 17 : 1 $\quad \therefore$ E.F is $C_9H_{17}O$

MM of Unknown = 706.3 g/mol

MM of E.F = 141.16 g/mol $\uparrow 5X$

$\therefore$ Unknown is $C_{45}H_{85}O_5$

#5 In 100g

$m_K = 26.65g \rightarrow \eta_K = 0.682$

$m_{Cr} = 35.33g \quad \eta_{Cr} = 0.679$

$m_O = 38.02g \quad \eta_O = 2.38$

$\Rightarrow$ K : Cr : O

$\frac{0.682}{0.679} : \frac{0.679}{0.679} : \frac{2.38}{0.679}$

1 : 1 : 3.5

2 : 2 : 7 ∴ EF is $K_2Cr_2O_7$

MM of unknown = 294.20 g/mol

MM of E.F = 294.20 g/mol ↑ x1

∴ Unknown is $K_2Cr_2O_7$

#6 In 100g

$m_C = 74g \rightarrow \eta_C = 6.16$

$m_H = 8.7g \quad \eta_H = 8.61$

$m_N = 17.3g \quad \eta_N = 1.08$

$\Rightarrow$ C : H : N

6.16 : 8.61 : 1.23

5 : 7 : 1

Thus E.F is C_5H_7N

MM of unknown = 162.26 g/mol

MM of E.F = 81.13 g/mol ↑ x2

∴ Unknown is $C_{10}H_{14}N_2$

p. 120

#8 In 100g

$m_{Na} = 21.9\,g \rightarrow n_{Na} = 0.952$

$m_C = 45.7\,g \quad n_C = 3.81$

$m_H = 1.9\,g \quad n_H = 1.88$

$m_O = 30.5\,g \quad n_O = 1.91$

~~C:H:O~~

Na : C : H : O

0.952 : 3.81 : 1.88 : 1.91

1 : 4 : 2 : 2

∴ E.F is $NaC_4H_2O_2$

MM of Unknown = 210 g/mol

" " E.F. = 105.1 g/mol ×2

∴ Unknown is $Na_2C_8H_4O_4$

#9 In 100g

$m_C = 49.38\,g \rightarrow n_C = 4.11$

$m_H = 3.55\,g \quad n_H = 3.51$

$m_O = 9.40\,g \quad n_O = 0.588$

$m_S = 37.67\,g \quad n_S = 1.17$

C : H : O : S

4.11 : 3.51 : 0.588 : 1.17

7 : 6 : 1 : 2

∴ E.F. = $C_7H_6OS_2$

MM of Unknown = 170.25 g/mol

MM of E.F. = 170.25 g/mol

∴ molecular formula is $C_7H_6OS_2$